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FROM: Lawson Anderson, E/A&H LA

SUBJECT: Northside Groundwater Investigation - Brainstorming Session; RCRA Facility Investigation, Naval Support Activity Memphis; CTO-094

DATE: October 21, 1996

On October 16 and 17, 1996, a "brainstorming" session was conducted to develop a proposed strategy for completing the SWMU 7/Northside groundwater investigation at NSA Memphis. The strategy will be presented to the NSA Memphis BRAC Cleanup Team (BCT) during the BCT meeting to be held October 21-23, 1996. Participants in the session were:

SOUTHDIV - Mark Taylor and David Porter
USGS - Jack Carmichael
E/A&H - Lawson Anderson and Larry Hughes

The session began with a review of the conceptual model of the nature and extent of groundwater contamination developed by E/A&H and a brief discussion of the geostatistical analysis of the groundwater data performed by Newfields, Inc. The model, which will also be presented to the BCT during the October meeting, is based on a review of potential source areas (including interviews with base personnel), a detailed comparison of contaminants detected in monitoring wells along the same flow paths (ratios of daughter products, time stability of ratios, etc.), site hydrogeology, attenuation factors, etc.

A 4-step approach was then used to develop the proposed strategy, as follows:

STEP 1 - List the conclusions and knowledge gained from the investigation to date (i.e., "what we know").

STEP 2 - List questions/concerns to be answered/addressed.

STEP 3 - Conduct a "sticky drill" to narrow the list of questions/concerns down to key issues and use the information compiled during Step 1 to answer as many of the Step 2 questions as possible.

STEP 4 - Identify the actions (i.e., investigative approach) required to answer unresolved questions.

After creating lists of "what we know" (see attached List 1) and "what we need to know" (see attached List 2), we addressed the questions/concerns based on whether they were related to the Memphis Sand as a receptor (List 3) or the fluvial deposits as a receptor (List 4).

Memphis Sand
The three major questions identified were:

- Who/what are the receptors?
- Is the aquifer protected?
- What risk reduction/risk management measures could be taken, if necessary?

The information compiled indicated:

- There are several current users (the NSA, the City of Millington, and the NSA golf course) and there could be additional users in the future (e.g., new industry).

- Considerable evidence has been gathered to indicate that the aquifer is protected (see List 3). Additional supporting evidence could be collected by evaluating the potential assimilative capacity of the organic carbon content of the Cockfield Formation, collecting isotopic data, determining if conditions are suitable for bioremediation in the Cockfield formation, and evaluating groundwater model results.

- Risk reduction/management measures are available, including closing production wells, treating groundwater before use, deed restrictions, and retaining groundwater rights.

Fluvial Deposits
The two major questions identified were:

- Are the plumes expanding?
- Will contaminants reach receptors?

Key findings of the fluvial deposits discussion were:

- There are multiple, small sources which result in low contaminant mass. Though possible sources have been better defined, the complexities associated with multiple, small sources prevent completely defining the nature and extent of contamination.
- DNAPLs are possible, but not indicated by contaminant concentrations detected.
- Contaminants are not migrating downward through the confining unit (Cockfield and Cook Mountain Formations).
- There is no indication that possible faults extend upward into the fluvial deposits.
- Bioremediation is occurring in some areas.
- We do not know extent of downgradient contamination to northwest. In addition to closing this data gap with groundwater sampling, modeling of attenuation factors (e.g., retardation, dispersion, etc.) is needed to estimate impact on plume expansion.
- There are no current on-base receptors. Off-base receptors include the Memphis Sand, private wells, and possibly surface water (none known).
- The point of compliance (POC) has not been defined. Once defined, modeling (groundwater flow/solute transport, bioremediation, etc.) can be performed.
- Long-term groundwater monitoring will be required for model confirmation and compliance.
- The ownership of groundwater rights after property transfer will affect the potential for impacting receptors.

Proposed Field Work
Many of the questions described above may be addressed through evaluation of existing data (groundwater sample results, Shelby tube analyses, aquifer characteristics, etc.) and/or different types of modeling (groundwater flow/solute transport, bioremediation, etc.). Field work proposed to answer the remaining questions includes:

- Assuming that a screening technology can be identified that will allow vertical profiling all the way to the bottom of the fluvial deposits (e.g., hydropunch), screen possible source areas to confirm the conceptual model is valid, to attempt to find

DNAPL or elevated contaminant concentrations that indicate the possible presence of DNAPL.

- Beginning at the suspected source area near the former interim status hazardous waste storage facility, conduct vertical profiling of the fluvial deposits along a groundwater flow path that includes two locations near the suspected source, sample near monitoring wells 4LF, 11LF, and 10LF, sampling at a location between 4LF and 11LF, and sampling in the vicinity of the proposed locations for downgradient POC wells (see attached figure). This path includes a possible DNAPL source area, the highest concentration of dissolved contaminants, the furthest downgradient contaminant detection, the steepest groundwater flow gradient, and a pattern of decreasing contaminant concentration. It will fill a possible data gap between monitoring wells 4LF and 11LF and provide an indication of whether contaminants have been missed at previously sampled locations due to the sampling interval.

- Assuming that groundwater rights will be retained by the Navy, install two types of POC monitoring wells — 1) wells to verify that natural attenuation is working and 2) wells to verify that contamination is not leaving the area of groundwater rights retention. Locations for POC monitoring wells used to monitor natural attenuation will be screened to ensure they are in clean, downgradient areas, but near the edge of suspected plumes. This will provide checks on the estimates for contaminant time of travel and on changes in contaminant concentrations and ratios (i.e., whether natural attenuation is working as predicted). Because the proposed POC wells are in an area of groundwater convergence, they will also fill the data gap to the northwest.

- Collect groundwater samples from the bottom of the fluvial deposits near the off-base dry cleaners to ensure possible source of PCE in BG5 wells was not missed (previous sample was from top of fluvial deposits).

- Collect soil and groundwater samples from the Cockfield Formation for remedial design parameter analyses to support modeling and evaluation of confining unit effectiveness.

LIST 1 - WHAT WE KNOW

1. Multiple sources/plumes in fluvial deposits
2. Cockfield Formation - No contaminants detected; no tritium detected.
3. Memphis Aquifer - No contaminants detected; no tritium detected.
4. Hydraulic heads indicate no communication between the Memphis Sand and shallow system (including the Cockfield Formation).
5. Flow directions/hydraulic gradients defined in fluvial deposits.
6. Cockfield/Cook Mountain Formations are present, low K_v, and thick.
7. Cockfield/Cook Mountain Formations believed to be high K_{oc}.
8. Fluvial deposits groundwater not used in immediate vicinity of base.
9. Fluvial deposits groundwater flow is 15 to 50 ft/yr.
10. Contaminants detected well below 1% of solubility (e.g., TCE = 11,000 ppb).
11. Natural bioremediation is occurring in some areas.
12. Nature and extent of random sources/plumes too complex to define (probable that additional sources/plumes have not and cannot be identified/defined).
13. Presence of DNAPL is possible, but not indicated by contaminant concentrations.
14. Upper fluvial and lower fluvial detections are not correlated.
15. Downgradient extent of contamination has not been defined to northwest of apron.
16. Water chemistry comparison between Memphis Aquifer and fluvial deposits groundwater indicates no communication.
17. No DNAPL detected/indicated in 25 lower fluvial deposits MWs in biased locations in the apron area (approx. 140 acres).
18. No solvents detected in loess soil.
19. Contaminants detected at concentrations greater than MCLs.
20. Groundwater flow in fluvial deposits is generally horizontal.

LIST 2 - QUESTIONS TO BE ANSWERED

1. Is DNAPL present?

2. Have subsurface source areas been identified?

3. Is the Memphis Aquifer protected?

4. What is the downgradient extent of contamination?

5. Is natural attenuation occurring? If so, can we assume it will occur in all areas/plumes?

6. Who/what are receptors?

7. Where is the point of compliance (POC) for receptor protection?

8. If contamination reaches POC, what is the contingency plan?

9. Is additional investigation needed (additional MWs, seismic, stratigraphic borings, hydropunch)?

10. Does faulting influence contaminant migration?

11. Is there a screening technology available to sample bottom of fluvial deposits?

12. Is additional data needed for groundwater model?

13. Has extent of contamination been defined vertically in fluvial deposits (i.e., has contamination been missed in non-screened intervals)?

14. Will any of the above questions impact transfer of property? If so, which questions?

LIST 3 -MEMPHIS SAND AS A RECEPTOR

Who/what are receptors?

Current users = NSA, city, golf course (non-potable)

Future users = NSA, city, golf course (non-potable), new industry

Risk reduction/management measures.

Close production well(s)

Treat groundwater

Deed restrictions

Navy retention of groundwater rights

Is the aquifer protected?

No contamination detected in the Cockfield Formation or the Memphis Sand.

No tritium detected in the Cockfield Formation or the Memphis Sand (tritium was detected in the fluvial deposits.

Heads between fluvial deposits/Cockfield Formation and Memphis Sand show no hydraulic communication - stresses from Memphis Sand pumping not seen in shallow system.

Known presence of thick and low K_v confining unit (Cockfield and Cook Mountain Formations).

Differences between geochemistry of groundwater in Memphis Sand and fluvial deposits.

Potential assimilative capacity of Cockfield Formation organic carbon.

Existing pretreatment (aeration) removes remaining VOCs, if any.

Isotopic data: C_{13}-C_{12} ratio and oxygen isotopes (faulted vs. non-faulted areas; fluvial deposits vs. Memphis Sand). (?)

Modeling results (?)

Shut down of Production Well No. 1.

No indication of DNAPL in fluvial deposits/Cockfield Formation.

Low contaminant mass and high pumping rate = great degree of dilution.

LIST 4 - FLUVIAL DEPOSITS AS A RECEPTOR

Are plumes expanding?

DNAPL is not indicated by concentrations detected.

Multiple, small sources (low mass).

Bioremediation is occurring in some areas (more evaluation is needed).

Groundwater moves at rate of 15 to 50 ft/yr.

Fluvial deposits have retardation capacity (more evaluation needed).

We do not know extent of downgradient contamination (northwest of apron).

Plumes not expanding vertically downward past confining unit (Cockfield/ Cook Mountain Formations).

No indication that possible faults extend upward into fluvial deposits (i.e., fluvial deposits much younger than faults).

Possible sources better defined; however, complete definition of nature and extent is not feasible due to complexities.

Modeling attenuation factors impact on plume expansion is needed.

Will contaminants reach receptors?

On-base receptors - none currently (see Memphis Sand as a receptor).

Off-base receptors - Memphis Sand, private wells, surface water (none known), future wells.

POC not defined. Once defined, modeling (groundwater flow/solute transport), bioremediation, etc.) will be performed.

Long-term groundwater monitoring required for model confirmation and compliance.

Ownership of water rights after transfer will affect potential for impacting receptors.

LIST 5 -FINAL INVESTIGATIVE ACTIVITIES TO ANSWER QUESTIONS

Vertical Groundwater Screening
Need to identify screening technology for vertical profiling all the way to bottom of fluvial deposits.

Conduct vertical profiles (5' depth intervals) in fluvial deposits along flow path that includes:

Two locations in suspected source area of fan-shaped plume

One each at locations of monitoring wells 4LF, 11LF, and 10LF

One between monitoring wells 11LF and 10LF

One (or more if not clean) at proposed location(s) for downgradient POC monitoring wells

Flow path includes:

Possible DNAPL source area

Highest dissolved contaminant concentration detected

Furthest downgradient contaminant detection

Steepest gradient

A pattern of decreasing contaminant concentration

P.O.C well(s) would be in an area of groundwater flow convergence (closing data gap to northwest).

Screen locations for POC wells to be used for monitoring natural attenuation to ensure they are located in clean areas.

Sample bottom of fluvial deposits near private dry cleaners (BG5 issue).

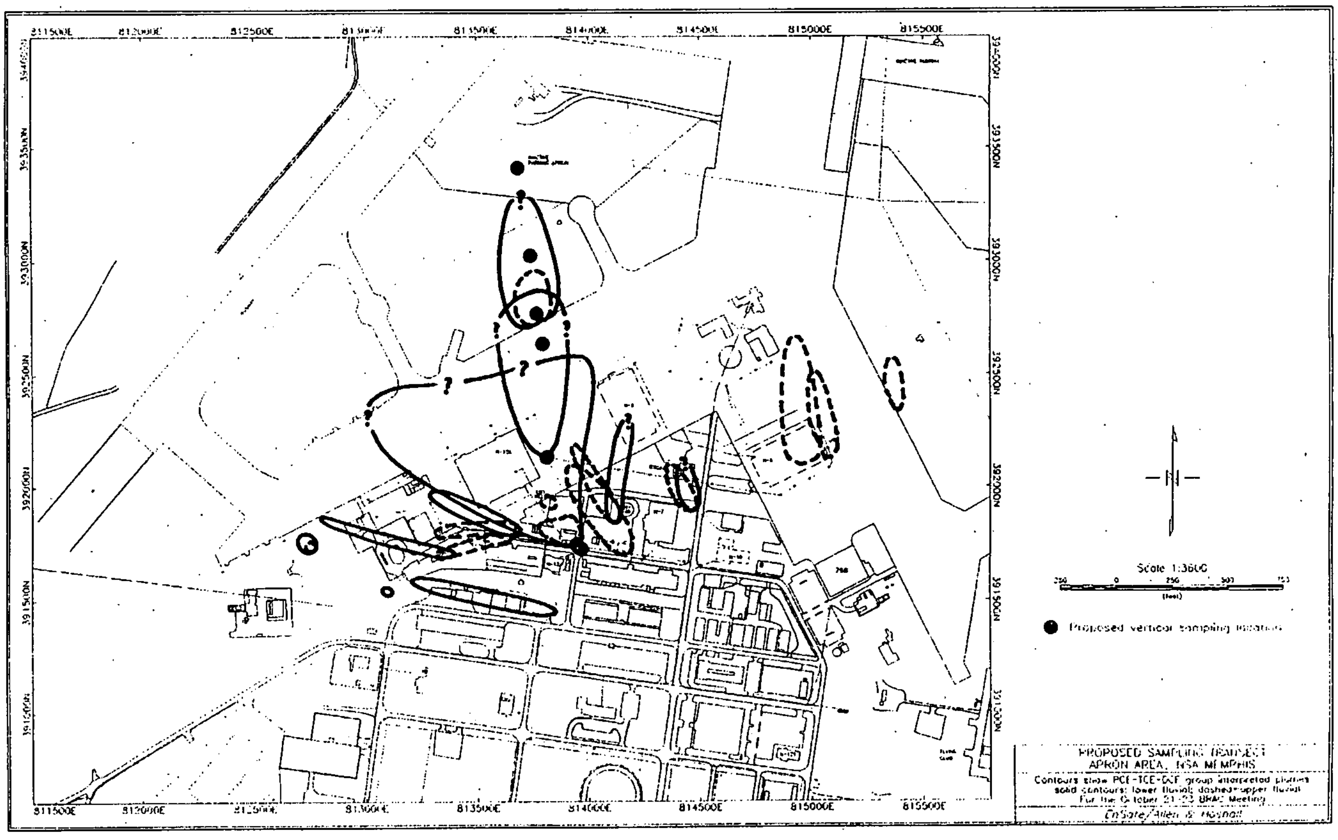
POC Monitoring Wells
Assume retaining groundwater ownership from east side of apron to current western boundary (fence line).

Two types of POC monitoring wells:

1) Verification that remedy (natural attenuation) is working.

2) Verification that contamination is not leaving area where groundwater rights have been retained.

To be installed after vertical groundwater screening.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Proposed vertical sampling location
PROPOSED SAMPLING TRANSECT
APRON AREA, NSA MEMPHIS
Contours show PCE-TCE-DCE group interpreted plumes
solid contours: lower fluvial; dashed=upper fluvial
For the October 21-23 BRAC Meeting
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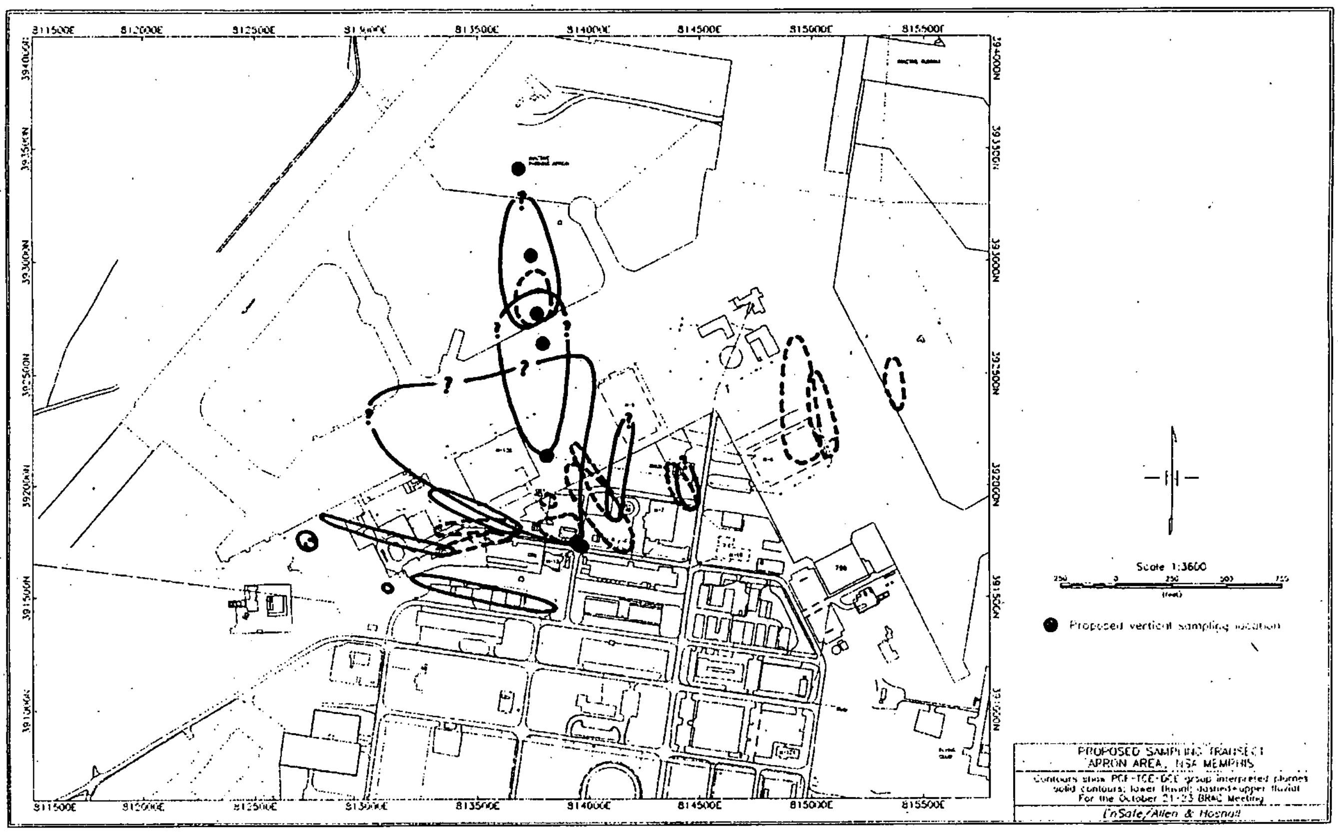
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Proposed vertical sampling location
PROPOSED SAMPLING TRANSECT
APRON AREA, NSA MEMPHIS
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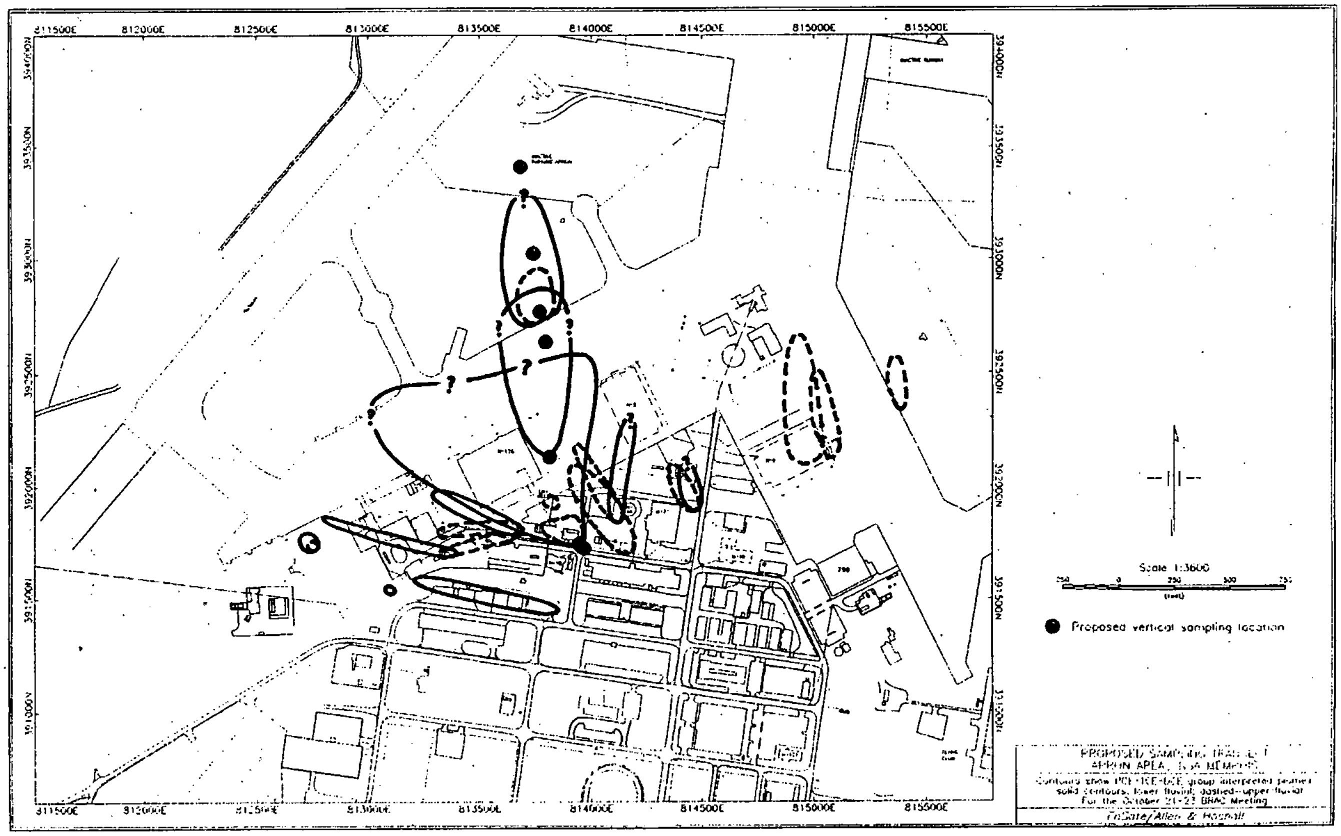
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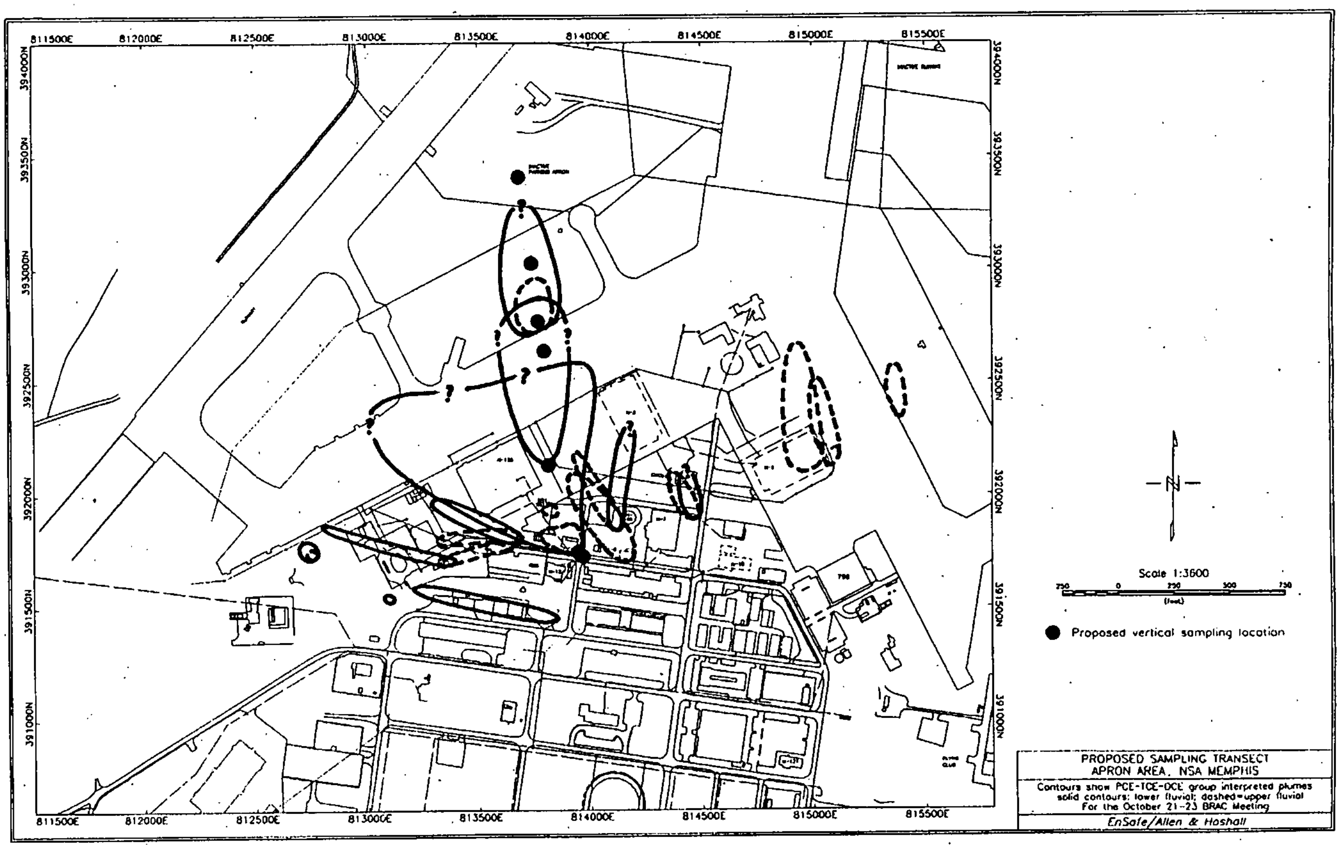

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